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10/666,671	09/17/2003	Hongqin Shi	PI18-US	8251
23494	7590	07/06/2007	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			VINH, LAN	
			ART UNIT	PAPER NUMBER
			1765	
			NOTIFICATION DATE	DELIVERY MODE
			07/06/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>
	10/666,671 Examiner Lan Vinh	SHI ET AL. Art Unit 1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

**A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.**

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) Responsive to communication(s) filed on 19 April 2007.
- 2a) This action is **FINAL**.                    2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) Claim(s) 1-3,5-21,24-30,32-54,56-64 and 66-71 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) Claim(s) 63,64 and 66-71 is/are allowed.
- 6) Claim(s) 1-2, 5-21,26-30,32-34, 37-54 and 56-62 is/are rejected.
- 7) Claim(s) 3,24,25,35 and 36 is/are objected to.
- 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) All    b) Some \* c) None of:
    1. Certified copies of the priority documents have been received.
    2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____ .
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ .	5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)
	6) <input type="checkbox"/> Other: _____ .

## DETAILED ACTION

### ***Response to Arguments***

1. Applicant's argument filed 4/19/2007 that argue that claim 1 is directed to an etching method that is not continuous or batch as described in Buskirk have been fully considered but they are not persuasive because this argument is not in commensurate with the scope of claim 1 since claim 1 does not recite "an etching method that is not continuous or batch". The applicants further argue that the undersigned can not find a step of measuring the amount of a chemical recipe in paragraph 0036 of Buskirk. However, Buskirk's teaching of "total flow rate of the reactive gas can be from about 1 sccm to about 10 sccm" in paragraph 0036 certainly reads on a step of measuring the amount of a chemical recipe in the process.

However, Applicant's arguments, see page 11 of the response, filed 4/9/2007, which argue that paragraph [0039} of Buskirk does not teach or suggest determining feeding time based on measurement an amount of a chemical species/varying etchant feeding rates in a single etching process is persuasive. Therefore, the rejection(s) of claims 1-2, 5-6, 10-12, 15, 17, 26-27, 30, 53 under 35 U.S.C. 102(b) as being anticipated by Buskirk et al (US 2002/0011463 A1) have been withdrawn. Upon further consideration and search, a new ground of rejection of claims 1-2, 5-6, 10-12, 15, 17, 26-27, 30, 53 under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) and newly cited reference of Donohue et al (6,784,108) is discussed below

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2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-2, 5-6, 10-12, 15, 17, 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108)

Buskirk discloses a dry cleaning process. The process comprises the steps of:

loading a microelectronic device/microstructure into an etch chamber of the etch system, wherein the sample comprises silicon /sacrificial material and a platinum layer/ structural materials (page 2, paragraph 0020, paragraph 0033, 0035)

providing a etchant recipe comprising XeF<sub>2</sub> vapor to etch the silicon/sacrificial layer (page 2, paragraph 0019, 0020)

measuring an amount of a etchant/chemical species in the process (page 2, paragraph 0036)

determining the time and condition for the reactive halide etch and empirically determining the nature of the etching while varying the time and contacting conditions such as concentration of the etching agent to identify the process condition (page 3, paragraph 0039), which reads on determining a etching time based on the measurement and further etching the sacrificial material by providing an additional amount of the spontaneous vapor phase etchant recipe to the etch system based on the determined etching time to continue the etch process

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Unlike the instant claimed invention as per claim 1, Buskirk does not specifically disclose determining a feeding time based on the measurement of the amount of a chemical species/etchants

Donohue discloses a etch profile control method comprises a step of determining a feeding time based on the measurement of the amount of a chemical species/etchants (col 10, lines 49-54; fig. 17). Donohue serves as an evidence that the feeding time is a result effective variable

Thus, one skilled in the art at the time the invention was made would have found it obvious to determine any feeding time, by conducting routine experimentation, based on the measurement of the amount of a chemical species/etchants in Buskirk method in view of Donohue teaching since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In regarding claim Boesch, 617 F.2d, 272, 205 USPQ 215 (CCPA 1980)

The limitation of claims 2, 5-6, 26-27 have been discussed above

Regarding claims 10-11, Buskirk discloses that the etchant comprises an inert/diluent gas (page 3, paragraph 0043)

Regarding claim 15, Buskirk discloses performing process in cycles (page 1, paragraph 0016), which reads on repeating the steps of the process

Regarding claim 17, Bskitk discloses that the etchant has a pressure of 50 mTorr-2 Torr (page 2, paragraph 0035)

4. Claims 30, 32-34, 37-39, 42-45, 48-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108)

Buskirk discloses a dry cleaning process. The process comprises the steps of:  
loading a microelectronic device/microstructure into an etch chamber of the etch system, wherein the sample comprises silicon /sacrificial material and a platinum layer/ structural materials (page 2, paragraph 0020, paragraph 0033, 0035)

providing a etchant recipe comprising XeF<sub>2</sub> vapor/noble gas halide to etch the silicon/sacrificial layer (page 2, paragraph 0019, 0020), wherein an amount of the etchant recipe per time/flow rate unit varies (page 2, paragraph 0036)

Unlike the instant claimed inventions as per claims 30, 32, Buskirk fails to disclose providing the etchant recipe at a first amount per unit time at a first time and providing the etchant recipe at a second amount per unit time at a second time, the second amount is difference from the first amount per unit time

Donohue discloses a etch profile control method comprises a step of providing the etchant recipe at a first amount per unit time/flow rate at a first time and providing the etchant recipe at a second amount per unit time/flow rate at a second time, the second amount is difference from the first amount per unit time (fig. 17). 17). Donohue serves as an evidence that the feeding time is a result effective variable

Thus, one skilled in the art at the time the invention was made would have found it obvious to vary the flow rate Buskirk method in view of Donohue teaching since it has been held that discovering an optimum value of a result effective variable involves only

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routine skill in the art. In regarding claim Boesch, 617 F.2d, 272, 205 USPQ 215 (CCPA 1980)

The limitations of claims 32-34, 42-43, 50 have been discussed above

Regarding claims 37-39, Buskirk discloses that empirically determining the nature of the etching while varying the time and contacting conditions such as concentration of the etching agent to identify the process condition

Regarding claims 44-45, Buskirk discloses that the etchant comprises an inert/diluent gas (page 3, paragraph 0043)

Regarding claims 48-49, Buskirk discloses that the platinum layer/structural layer remains after the silicon layer is removed

5. Claims 53-54, 58-59, 61-62 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108)

Buskirk discloses a dry cleaning process. The process comprises the steps of: providing a etchant recipe comprising  $XeF_2$  vapor/noble gas halide to etch the silicon/sacrificial layer (page 2, paragraph 0019, 0020), determining the time and condition for the reactive halide etch and empirically determining the nature of the etching while varying the time and contacting conditions such as concentration of the etching agent/etchant recipe to identify the process condition (page 3, paragraph 0039),

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Unlike the instant claimed inventions as per claim 53, Buskirk fails to disclose varying the amount of the etchant recipe/flow rate from a first amount to a second amount wherein both the first and second amount are not zero

Donohue discloses a etch profile control method comprises a step of providing the etchant recipe at a first amount per unit time/flow rate at a first time and providing the etchant recipe at a second amount per unit time/flow rate at a second time, the second amount and first amount are not 0 (fig. 17). 17). Donohue serves as an evidence that the flow rate/etchant recipe amount is a result effective variable

Thus, one skilled in the art at the time the invention was made would have found it obvious to vary the flow rate Buskirk method to achieve a first and second amount in view of Donohue teaching since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In regarding claim Boesch, 617 F.2d, 272, 205 USPQ 215 (CCPA 1980)

The limitation of claim 54, 58-59 have been discussed above

Regarding claims 61-62, Buskirk discloses that the etchant comprises an inert/diluent gas (page 3, paragraph 0043)

6. Claims 7-8, 40-41, 56-57 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108) and further in view of Tai et al (US 6,436,229)

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Buskirk and Donohue method has been described above. Unlike the instant claimed invention as per claims 7-8, 40-41, 56-57, Buskirk and Donohue fails to disclose using BrF<sub>3</sub> as a vapor etchant

Tai discloses a method for etching comprises the step of etching silicon using BrF<sub>3</sub> (col 3, lines 10-15)

One skilled in the art at the time the invention was made would have found it obvious to substitute Buskirk and Donohoe xenon difluoride vapor etchant with BrF<sub>3</sub> as per Tai because Tai discloses that BrF<sub>3</sub> has higher etching efficiency than that of xenon difluoride and BrF<sub>3</sub> is also cost effective when compared with the use of xenon difluoride (col 3, lines 5-10)

7. Claims 9, 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108) and further in view of Zhang et al (US 6,162,585)

Buskirk and Donohoe method has been described above. Unlike the instant claimed inventions as per claims 9, 60, Buskirk and Donohoe fails to disclose using a vapor etchant recipe comprises of xenon difluoride instead of HF

Zhang discloses a method for etching using vapor HF (col 5, lines 39-40)

Hence, one skilled in the art at the time the invention was made would have found it obvious to modify Buskirk and Donohoe method by using vapor HF etching as per Zhang because Zhang discloses that the allowable duration of vapor HF etching allows deeper etch (col 5, lines 63-67)

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8. Claims 13-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view Donohue et al (US 6,784,108) and further in view of Tai et al (US 6,436,229)

Buskirk and Dpnohoe method has been described above. Unlike the instant claimed inventions as per claims 13-14, Buskirk and Donohoe fails to disclose the steps of preparing the etchant in vapor reservoir /exchange chamber and supplying the etchant through a loop that passes through the etch-chamber

Tai discloses the step of preparing the etchant in vapor reservoir 120/exchange chamber and supplying the etchant through a loop that passes through the etch-chamber 110 (fig. 1A)

One skilled in the art at the time the invention was made would have found it obvious to modify Buskirk and Donohoe method by adding the step of preparing the etchant in vapor

reservoir /exchange chamber and supplying the etchant through a loop that passes through the etch-chamber as conventional known in the art as taught by Tai

8. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A) in view of Donohue et al (US 6,784,108) and further in view of Chinn et al (US 6,666,979)

Buskirk and Donohoe method has been described above. Unlike the instant claimed invention as per claim 16, Buskirk and Donohoe fails to disclose coating the microstructure with a SAM

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Chinn discloses a method for dry etch comprises the step of coating the microstructure with a SAM (col 11, lines 18-45)

Hence, one skilled in the art at the time the invention was made would have found it obvious to modify Buskirk and Dohonoe method by coating the microstructure with a SAM to prevent stiction during handling (col 11, lines 16-19)

9. Claims 18-21, 46-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view Donohue et al (US 6,784,108) and further in view of Han et al (US 6,740,247)

Buskirk and Donohoe method has been described above. Unlike the instant claimed inventions as per claims 18-21, 46-47, Buskirk and Donohoe fails to disclose that the diluent gas has a partial pressure from 20-700 Torr

Han discloses a method for HF vapor cleaning/etching comprises the step using a nitrogen /diluent gas has a partial pressure from 10-500 Torr (col 7, lines 55-57)

One skilled in the art at the time the invention was made would have found it obvious to modify Buskirk and Donohoe method by using a nitrogen/diluent gas has a partial pressure of 10-500 Torr to enable stabilization of the operating chamber pressure as taught by Han (col 7, lines 55-58)

10. Claims 28-29, 51-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buskirk et al (US 2002/0011463 A1) in view of Donohue et al (US 6,784,108) and further in view of Chen et al (US 6,159,851)

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Buskirk and Donohoe method has been described above. Unlike the instant claimed invention as per claims 28-29, 51-52, Buskirk and Donohoe fails to disclose that the structural material comprises a elemental metal and a metal nitride

Chen discloses a method for forming a semiconductor device comprises the step of forming a TiN layer with a primary conductive layer (col 6, lines 4-6)

Thus, one skilled in the art at the time the invention was made would have found it obvious to modify Buskirk and Donohoe method by forming a metal nitride as per Chen because Chen discloses that the TiN provides conformal adherent coating on a lower metal (col 5, lines 14-16)

### ***Allowable Subject Matter***

11. Claims 3, 24-25, 35-36 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 63-64, 66-71 allowed.

The reason for allowance of claim 63 has been stated in the previous office action

### ***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



LV

June 26 , 2007